REMARKS

Claims 1-4, 6-12, 14-29, 31-37 and 39-45 are currently pending in the application.

Claims 1-4, 6-12, 14-29, 31-37 and 39-45 stand rejected.

35 U.S.C. § 102 Anticipation Rejections

Claims 1, 2, 4, 6, 8-12, 14-20, 24-27, 29, 31, 33-37 and 39-45 were rejected under 35 U.S.C. § 102(b) as being anticipated by Marrs, (U.S. Patent 5,701,034). Applicants respectfully traverse this rejection as hereinafter set forth.

Applicants submit that a claim is anticipated only if each and every element as set forth in the claim is found either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Marrs describes a packaged integrated circuit including a heat sink with a locking moat. (Col. 5, lines 1-3). A semiconductor die is attached to a surface of a heat sink using adhesive. (Col. 5, lines 6-8). Package leads are attached to the heat sink also using adhesive. (Col. 5, lines 15-16). Using conventional bond wiring methods the bond wires are extended between the bond pads on the semiconductor die and the heat sink. (Col. 5, lines 18-24). The die, heat sink, bond wires and inner portions of package leads are encapsulated by molding in encapsulant. (Col. 5, lines 24-28). The encapsulant fills in the locking moat formed in the heat sink and becomes interlocked with the heat sink. (Col. 5, lines 29-32).

By way of contrast to Marrs, the embodiment of the invention set forth in claim 1 recites elements of the invention calling for an integrated circuit package comprising "a package body; an integrated circuit die positioned within the package body; a lead frame including a plurality of leads having portions enclosed within the package body" and an electrically conductive heat sink positioned at least partially within the package body with a surface of a first portion of the heat sink facing the lead frame in lose proximity to a substantial part of the enclosed portion of at least eighty percent of the area formed by the plurality of leads of the lead frame". Marrs does not disclose an integrated circuit die positioned within the package body, nor does Marrs disclose a

lead frame having a plurality of leads having portions enclosed within the package body. Furthermore, Marrs fails to describe, either expressly or inherently, "a second portion of the heat sink projecting away from the first portion of the heat sink under the die-attach area".

Applicants respectfully submit that Marrs fails to describe, either expressly or inherently "an integrated circuit die positioned within the package body; a lead frame including a plurality of leads having portions enclosed within the package body that connect to the integrated circuit die, the plurality of leads having portions enclosed within the package body forming an area; and an electrically conductive heat sink positioned at least partially within the package body with a surface of a first portion of the heat sink facing the lead frame in close proximity to a substantial part of the enclosed portion of the at least eighty percent of the area formed by the plurality of leads of the lead frame having portions enclosed within the package body and with a die-attach area on the surface of the first portion of the heat sink attached to the integrated circuit die, a second portion of the heat sink projecting away from the first portion of the heat sink under the die-attach area and the integrated circuit die, the heat sink coupled to one of a signal voltage and a reference voltage so the heat sink operates respectively as a signal plane and a ground plane for the plurality of leads of the lead frame." In Marrs the package body 101 is covered with an encapsulant 120. (FIG. 1, Col. 5, lines 3-4). The leads 102 are external to the integrated circuit or semiconductor die and are attached to heat sink 110 using adhesive 118. (Col. 5, lines 13-15) and are partially covered with encapsulant 120. Furthermore, Marrs does not disclose "an electrically conductive heat sink". Marrs description sets forth that the packaged integrated circuit 200 may be placed on a conductive layer 206, which is sandwiched in between dielectric layers 204 and 208, which are formed around the periphery of the die 101. (Col. 5, lines 34-42). The Applicants' invention incorporates a conductive or ground plane property into the heat sink itself, not the underlying substrate. Thus, Marrs does not describe the elements of Applicants' claimed invention.

Additionally, Marrs does not describe either explicitly or inherently "a die-attach area on the surface of the first portion of the heat sink attached to the integrated circuit die, a second portion of the heat sink projecting away from the first portion of the heat sink". Marrs discloses a single piece heat sink 110 having a locking moat 112. (FIG. 1). Since Marrs describes only a

single piece heat sink, Marrs cannot describe a second portion projecting away from the first portion of the heat sink.

As Marrs fails to expressly or inherently identically describe every element of claim 1, Applicants submit that claim 1 is not anticipated by Marrs under 35 U.S.C. § 102.

Claims 2, 4, 6, 8-12, 14-20, 24-27, 29, 31, 33-37, 39-45 are each allowable as depending either directly or indirectly from allowable claim 1.

Independent claim 24 is allowable as Marrs does not describe "a vertically extending columnar portion surrounded by a horizontally extending skirt portion". Marrs discloses a one-piece heat sink 110. (FIG. 1). Furthermore, the heat sink in Marrs does not vary in thickness. (FIGs. 1, 2A, 2B, 4, 8). Since Marrs fails to disclose each and every element of claim 24, Applicants respectfully submits that claim 24 is not anticipated by Marrs.

Independent claim 25 is allowable as Marrs does not describe "a second portion of the heat sink projecting away from the first portion of the heat sink under the die-attach area and the integrated circuit die, the heat sink coupled to one of a signal voltage and a reference voltage for the heat sink to operate respectively as a signal plane and a ground plane for the plurality of leads of the lead frame." Marrs discloses that the packaged integrated circuit 200 may be placed on a conductive layer 206, which is sandwiched in between dielectric layers 204 and 208, which are formed around the periphery of the die 101 and are external to the heat sink. (Col. 5, lines 34-42). The Applicants' invention incorporates a conductive or ground plane property into the heat sink itself, not the underlying substrate. Since Marrs fails to describe each and every element of claim 25, Applicant respectfully submits that claim 25 is not anticipated by Marrs under 35 U.S.C. § 102.

It is stated in the Office Action that "Marrs teaches that a first portion of the heat sink facing the lead frame is very near to a substantial part of the enclosed portion of all (100 percent) of the area formed by the plurality of leads of the lead frame having portions enclosed within the package body." The discussion of the description of Marrs above is incorporated herein by reference. Heat sinks must be positioned close to or even touching the package body in order for convective heat transfer to occur. Without convective heat transfer a heat sink is ineffective. While Marrs teaches a heat sink facing a lead frame, the package body is itself encased within the

encapsulant. Marrs does not enclose the lead frame within the package body. Furthermore, also as discussed above, Marrs describes a unitary heat sink construction, not a first and second portion heat sink as recited by Applicants' invention.

Claim 26-29, 31, 33-37, 39-45 are each allowable as depending either directly or indirectly from allowable claim 25.

35 U.S.C. § 103 Obviousness Rejection in the Alternative

Obviousness Rejection Based on U.S. Patent 5,701,034 to Marrs

Claims 1, 2, 4, 6, 8-12, 14-20, 24-27, 29, 31, 33-37 and 39-45 stand rejected in the alternative as being unpatentable over Marrs (U.S. Patent 5,701,034). Applicant respectfully traverses this rejection as hereinafter set forth.

M.P.E.P. § 706.2(j) sets forth the standard for a § 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947, F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

The discussion of Marrs above is incorporated herein by reference. It is asserted in the Office Action that the Applicants provide mere dimensional limitations that are prima facie obvious under 35 U.S.C. § 103(a) in the absence of a disclosure that limitations are critical or produce unexpected results. It is further asserted that it would have been an obvious matter of design choice to select the particular relative dimensions of the heat sink. Applicants respectfully disagree with such assertions. The differences in heat sinks between Marrs and Applicants' invention are not mere differences in dimensions. Applicants' invention discloses a heat sink with two individual portions, each portion having a distinguishable shape. Independent claims 1

and 25 recite a heat sink with "the surface of the first portion of the heat sink attached to the integrated circuit die" and a "second portion of the heat sink projecting away from the first portion of the heat sink." Independent claim 24 recites a heat sink with "a vertically extending columnar portion surrounded by a horizontally extending skirt portion." Additionally, the disclosure recites that the specific shape and design of the heat sink, where the second portion of the heat sink projects away from the first portion of the heat sink, provide improved performance of the heat sinks of the present invention as compared with conventional heat sinks. (Page 9, lines 4-29, page 10, lines 1-3, page 12, lines 4-9, page 13, lines 19-24). The separate portions of the heat sink according to the Applicants' invention improve performance and allow the invention to be used with a greater range of components. The dimensions of the Applicants' invention determine which electrical components may be used with the heat sink since the size of the second portion projecting away depends on the amount of heat to be dissipated.

Accordingly, Marrs cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the claimed invention for the reasons above.

35 U.S.C. § 103 Obviousness Rejection

Obviousness Rejection Based on U.S. Patent 5,701,034 to Marrs in view of U.S. Patent 5,696,031 to Wark

Claims 3, 22 and 28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Marrs (U.S. Patent 5,701,034) in view of Wark (U.S. Patent 5,696,031) as applied to claims 1, 2, 4-6, 8-20, 24-27, 29-31 and 33-45.

The discussion of Marrs above is incorporated herein by reference. Wark discloses a device and method for stacking wire-bonded integrated circuit dice on flip-chip bonded integrated circuit dice. In addition, Wark teaches a multi-chip module which is incorporated into a memory device and forms part of an electronic system that includes an input device, an output device, and a processor. The multi-chip module may be incorporated into any of the devices in the module. (Col. 5, lines 59-65).

Applicant respectfully submits that Marrs and Wark fail to teach or suggest the elements of independent claim 22 to establish a *prima facie* case of obviousness under 35 U.S.C. § 103

regarding the elements of the claimed invention of an integrated circuit package that includes an electrically conductive heat sink with "the surface of the first portion of the heat sink attached to the integrated circuit die" and a "second portion of the heat sink being opposite the die-attach area and projecting away from the first portion of the heat sink." Marrs teaches a one-piece heat sink construction as discussed above. Wark teaches stacking the integrated circuit dice to achieve greater component density in the construction of an electronic system.

Applicants submit that the references themselves teach away from the proposed combination and cannot establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the claimed invention since Marrs is directed toward preventing delamination of the encapsulating material. Wark teaches away from mounting integrated circuit devices on heat sinks, since stacking would prevent the heat sinks from operating effectively and would transfer heat to the lower component in the stack. It would not be obvious to combine a method for stacking heat generating integrated circuit devices (Wark) with a method of interlocking encapsulant with a heat sink.

Accordingly, any combination of Marrs and Wark cannot and does not establish a *pram facie* case of obviousness under 35 U.S.C. § 103 regarding the claimed invention.

Claims 3 and 28 are each allowable as depending, either directly or indirectly from allowable claims 1 and 25 respectively.

It is stated in the Office Action that "Marrs teaches the surface 110b of the first portion of the heat sink attached to the integrated circuit die." The discussion of Marrs above is incorporated herein by reference. Applicants respectfully submit that Marrs does not teach this limitation. FIG. 1 of Marrs shows that surface 110b is the surface of a one-piece heat sink in contact with the package body. Marrs does not teach a two-piece heat sink. Applicant respectfully suggests that Marrs does not teach or suggest the claimed limitation.

It is further stated in the Office Action that "a second portion of the heat sink 110a projecting away from the first portion of the heat sink" is taught by Marrs. Applicants respectfully submit that Marrs does not teach or suggest the claimed limitation. FIG. 1 of Marrs shows a one-piece heat sink having a surface 110b facing the integrated circuit to be cooled and an opposing surface 110a. Surface 110a is part of the heat sink and is not a separate or second

portion. It is not possible to separate the heat sink as taught by Marrs into a first portion and a second portion. Furthermore, the surface 110a does not project away from the first portion of the heat sink; rather it is merely the opposing surface of a continuous, one-piece heat sink.

It is stated in the Office Action that Marrs teaches "a vertically extending columnar portion surrounded by a horizontally extending skirt portion (rim/periphery/edge)." Applicants respectfully suggest that the claim limitations are not taught by Marrs. Marrs forms a column by removing material to create a moat or trench around the component mounting area. The heat sink with moat remains a part of the one-piece heat sink. Applicants' invention utilizes a two-piece construction that involves a taller column formed separately. While Marrs teachings may allow for the column to be elevated, that does not teach or suggest the two-piece construction with a significant height difference between the first and second portion as shown in FIGS. 1B and 1C or applicants' invention. Having failed to teach or suggest each and every limitation of the claims, the cited prior art cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the claimed invention.

ENTRY OF AMENDMENT

Applicants request entry of this amendment for the following reasons:

The amendment is timely filed.

The amendment clearly places the application in condition for allowance.

The amendment does not require any further search or consideration.

CONCLUSION

Claims 1-4, 6-12, 14-29, 31-37 and 39-45 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Applicants request the allowance of such claims and the case passed for issue. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicants' under attorney.

Respectfully submitted,

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Enclosure: Version with Markings to Show Changes Made

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